

# Dataset description: Error-related potentials (ErrPs) during continuous feedback

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last updated: March 10, 2015

This document describes the dataset<sup>1</sup> we analyzed for a study [1], in which EEG data was recorded from 10 subjects who controlled a simple video game with a gamepad and errors were elicited during continuous feedback.

## Data acquisition

### Experimental setup

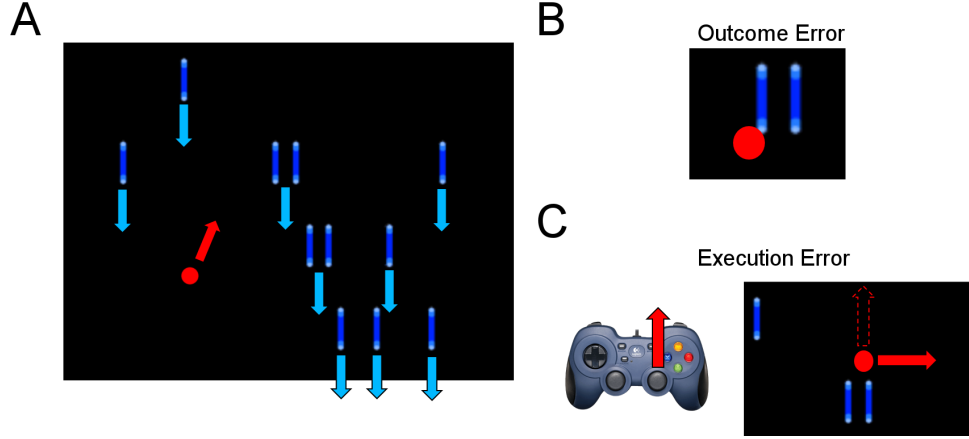
10 healthy subjects (mean age:  $24.1 \pm 1.1$  years) were recruited for this study. EEG was measured with two g.tec g.USBamp amplifiers and a Brainproducts Acticap System. 28 electrodes were placed on the scalp of the subject to measure EEG (at positions Fpz, AFz, F3, Fz, F4, F8, FC3, FCz, FC4, T7, C3, Cz, C4, T8, CP3, CPz, CP4, P7, P3, Pz, P4, P8, PO7, POz, PO8, O1, Oz, O2), while 3 electrodes were placed below the outer canthi of the eye and above the nasion for electrooculogram (EOG) recordings. The data was recorded with a sampling rate of 512 Hz and a 50 Hz notch filter was applied to filter out power line noise, as well as an additional bandpass filter between 0.5 Hz and 60 Hz. The position of the thumbstick as well as information about outcome or execution errors was transmitted to the recording software using the parallel port of the computer.

### Task description

For the experimental task, the subject had to play a simple video game (depicted in Figure 1). The subject used the right thumbstick of a gamepad to control the angle in which the cursor moved on the screen. The task was to avoid collisions of the cursor with blocks dropping from the top of the screen with a constant speed. The speed of the falling blocks was set to a level that the game was challenging and the player collided with a block from time to time. In case of a collision, the game continued for 1 second and then stopped. The delay of 1 second was introduced to make sure that the reaction measured in the EEG originates from the subject recognizing the collision (outcome error) and not from the game stopping or restarting. To study the execution error, which is happening when the interface delivers erroneous feedback, the angle of the cursor movement was modified for the duration of 2 seconds. The degree of modification was randomized (45 °, 90 °, 180 ° to either the left or the right side). The time between two execution errors was randomized to be between 5 and 8 seconds.

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<sup>1</sup>can be downloaded at: [http://www-ti.informatik.uni-tuebingen.de/~spueler/eeg\\_data/](http://www-ti.informatik.uni-tuebingen.de/~spueler/eeg_data/)



**Figure 1.** A) Picture of the paradigm. The red and blue arrows indicate the movement direction of the objects (blue) and the cursor (red). The subject could move the red cursor with the gamepad to avoid a collision with one of the blue blocks, which were continuously falling down from the top of the screen. B) Example of an outcome error, when the cursor collided with a block. C) Example of an execution error, when the cursor moved for 2000 ms in a different direction than indicated by the subject through gamepad control. The dashed arrow in the screenshot indicates the expected movement direction, while the solid red arrow indicates the actual, erroneous direction.

## Structure of the dataset

In total the dataset consists of 10 sessions (one session for each of the 10 subjects). The data for each session is saved in a separate *.mat* file which can be read using MATLAB software. The EEG data for each session has already been cut into trials with the corresponding labels. Each *.mat* file contains the following variables:

- *eeg\_signal* - this variable has dimensions  $samples \times channels$ . It contains the complete EEG data of the one session. The first 28 channels are the EEG channels, while channels 29, 30, 31 are EOG channels.
- *info* - this struct contains information about the subject, the samplingrate and the channel names (according to 10-20 system).
- *marker* - this struct contains information about the errors and the thumbstick position. This struct will be described below in more detail.

The struct *marker* contains the following variables:

- *execution\_error* - this variable has dimensions  $samples \times 1$  and is 1 if an execution error is happening at that time point (0 otherwise).
- *execution\_error\_angle* - if an execution error is happening, this variable describes the angle modification of the error (in  $^{\circ}$ ) or is -1 if no execution error is happening.
- *outcome\_error* - this variable has dimensions  $samples \times 1$  and is 1 if an outcome error (collision) is happening at that time point (0 otherwise). Since the game is stopped after an outcome error (with delay of 1 s), this variable has a value of 1 until the game resumes.

- *thumbstick\_angle* - this variable has dimensions *samples*  $\times$  *1* and shows the position of the thumbstick. The data is saved in 6 ° resolution and a value of -1 means that the thumbstick is in a neutral position.

Please cite [1] when you use this dataset in a publication.

## References

1. Spüler M, Niethammer C (2015) Error-related potentials during continuous feedback: using EEG to detect errors of different type and severity. *Frontiers in Human Neuroscience* 9:155. doi: 10.3389/fnhum.2015.00155.